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FOREST INSECT INVESTIGATIONS

ANNUAL REPORT
FOREST INSECT FIELD STATION
COEUR D'ALENE, IDAHO
1932

COOPERATIVE CONTROL PROJECTS

By
James C. Evenden
Entomologist

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BUREAU OF ENTOMOLOGY
Forest Insect Field Station,
Coeur d'Alene, Idaho.

ANNUAL FOREST INSECT STATUS REPORT
SEASON 1932.

To Officers in Charge of Organizations:

It is requested that this report be circularized through that portion of your organization interested in forest protection.

James C. Evenden, Entomologist.

Forest Insect Field Station,
Coeur d'Alene, Idaho,
January 23, 1933.

ANNUAL FOREST INSECT STATUS REPORT
SEASON 1932

INTRODUCTION

The purpose of this report is to present not only a summary of the annual insect status reports submitted from the ranger districts of Region 1, but to include a brief resume of the entomological activity within the region during the past season. During the nine years that these ranger reports have been submitted, an excellent and valuable historical reference has been compiled at this station, which increases in value as data is accumulated. The character of the data submitted has improved with each year's reports, indicating a better understanding and appreciation of the seriousness of forest insect problems.

Though as a whole these reports satisfactorily depict existing conditions in many instances improvements can be made which will produce a more standardized result. The following comments refer to the different captions on the form used by the rangers in submitting their annual report:

1. Name of Area Affected. - The same local name for an infested area should be used each year. Variations in these names produce confusion in identifying the area in question.

2. Location. - Legal subdivisions as well as general locations should be given. A complete location of the area being reported upon is essential in identifying the area.

3. Number of Acres. - Refers to the total infested area and not the size of the spot actually examined. The acreage necessary to cover if control is instituted.

4. Extent of Attack. - Under this caption there should be given an idea of the intensity of the infestation - the number of red-tops or new attacks, for without such information a picture of the severity of the outbreak can not be drawn. Some field work will undoubtedly be necessary if this question is correctly answered.

5. Infested areas should be followed from year to year, or until such a time as the infestation is no longer of importance and should then be so reported. Areas have been reported with severe increasing outbreaks and the following season no mention made of the situation. Was the first report an erroneous one, or was the area overlooked the second season?

6. Each report should be confined to one insect. - Outbreaks of the mountain-pine beetle and Douglas-fir beetle are often included in the same report. It would be far better to list each insect on a separate sheet. Many rangers do this.

7. Remarks. - Nearly all reports were sadly in need of the personal reaction of the forest officer preparing them. After an officer has spent some time in the examination of an infested area a few remarks often prove to be of intense value.

In addition to the above items it is believed that there may be a tendency to minimize the importance of the few infested trees which are often encountered along trails and highways. The presence of such trees should be viewed with alarm, and a more thorough examination made in order to determine the actual status of the infestation. Through the lack of appreciation as to the importance of small groups of infested trees, serious outbreaks often develop - outbreaks which not only require large sums of money for suppression but are difficult to control.

These annual reports provide the only available source to which one may turn for a picture of existing conditions within the district. If they are to provide reliable information they must be based upon authentic data, and each ranger should be permitted to devote sufficient time to the examination of each infested area to fully satisfy himself as to existing conditions. To properly report upon an infestation some field work is necessary if the report is to be complete. Special training for these examinations is not necessary, but it is essential that the reporting officers realize the responsibility and seriousness of their task and take advantage of all available information which will tend to make the data secured more valuable.

SUMMARY OF RANGER REPORTS
1932

One hundred and fifty-four reports were received from 112 ranger districts. This is an increase of 3 reports and 4 ranger districts over the 1931 season. Of these reports, 12 were negative in character and 142 listed various insect infestations. Of the 142 insect infestations listed, 88 were considered as increasing, 29 as decreasing, and 25 as normal or stationary. There were 119 Dendroctonus outbreaks recorded, 11 spruce budworm, 5 true-fir beetle (Scolytus ventralis) and 7 infestations of spruce gall aphid, Ips, flathead borers, needle rusts, etc.

The following table shows the status of the different insects reported:

SUMMARY OF INSECT INFESTATIONS REPORTED

INSECT	YEAR	INCREASING	DECREASING	NORMAL	TOTAL
Mountain Pine Beetle D. monticolae Hopk.	1932	64	20	12	96
	1931	51	27	14	92
	1930	60	24	14	98
	1929	45	14	23	82
	1928	33	13	10	56
Western Pine Beetle D. breviconis Lec.	1932	2	2	0	4
	1931	2	1	1	4
	1930	4	1	0	5
	1929	0	3	4	7
	1928	5	4	2	11
Douglas Fir Beetle D. pseudotsugae Hopk.	1932	13	1	5	19
	1931	2	5	1	8
	1930	4	2	4	10
	1929	2	1	2	5
	1928	5	4	2	11
Lodgepole Pine Beetle D. murrayanae Hopk.	1932	0	0	0	0
	1931	0	0	1	1
	1930	0	0	1	1
	1929	-	-	-	-
	1928	-	-	-	-
True-Fir Beetle Scolytus ventralis Lec.	1932	5	0	0	5
	1931	0	0	1	1
	1930	2	0	0	2
	1929	1	0	0	1
	1928	0	0	1	1
Spruce Budworm Cocoecia fumiferana Clem.	1932	3	7	1	11
	1931	1	7	1	9
	1930	6	5	6	17
	1929	4	9	3	16
	1928	11	12	4	27

From the preceding table it will be seen that there has been but a slight change in the general status of conditions with the exception of the Douglas Fir Beetle. The status of the reports of mountain-pine beetle infestations in white pine remains practically the same as in 1931. Since 1928, these reports have been as follows:

Year Reported	No. of Reported White Pine Infestations	Increasing Infestations	Decreasing or Normal Infestations
1932	25	10	15
1931	26	11	15
1930	42	22	20
1929	40	24	16
1928	27	18	9

The following table shows the number and status of ranger reports covering mountain-pine beetle infestations in white pine, submitted from the different forests in 1932.

MOUNTAIN-PINE BEETLE INFESTATIONS IN WHITE PINE

Forest	No. of Reports	No. reported in 1931	Increasing Infestation	Decreasing Infestation	Normal Infestation	Recommendations for Control
Blackfeet	2	2	-	2	-	No
Cabinet	0	2	-	-	-	No
Clearwater	3	4	3	-	-	No
Coeur d'Alene	4	3	2	2	-	Yes for 2 areas.
Flathead	2	1	1	1	-	No
Kaniksu	4	5	-	4	-	Yes for 1 area.
Kootenai	2	1	2	-	-	No
Pond Oreille	4	5	-	3	1	No
St. Joe	4	3	2	1	1	Yes for 3 areas.
	25	26	10	13	2	

The above table shows but a slight change in the status of the mountain-pine beetle infestation in white pine. Though more infestations were reported from the Coeur d'Alene and Kootenai Forests, conditions on these two areas are much better than in 1931, following control operations. Though one less report was received from the Clearwater, it is rather apparent that on the Cook Mountain area at least the infestations on this forest have materially increased since 1931.

The Supervisor of the Blackfeet reports a marked decrease in white pine infestations. On the Flathead the Supervisor is not alarmed at conditions, while on the Kaniksu all infestations were considered as decreasing though control was recommended for one area. The Pend Oreille reports four decreasing infestations, though not a great deal of data were submitted. There was an increase from 3 to 4 in the number of reports received from the St. Joe, and it would seem that a rather serious infestation may be pending in that forest.

There has been no abatement in the seriousness of the mountain-pine beetle infestation in the lodgepole-pine forests of the Region. As in 1931, reports of lodgepole-pine infestations were received from 18 of the 20 regional forests. In 1931 there were 43 increasing infestations reported from 15 forests while in 1932 there were 54 reports of such outbreaks received from 13 forests. The following tabulation shows the status of the reports received from the different forests:

MOUNTAIN-PINE BEETLE INFESTATIONS IN LODGEPOLE PINE

Forest	No. of 1932 Reports	No. Reported in 1931	Increasing Infestations	Decreasing Infestations	Normal Infestation	Recommendations for Control
Beaverhead	7	7	7	-	-	For 1 area
Bitterroot	6	13	4	2	-	No
Blackfeet	4	2	1	2	1	No
Cabinet	0	1	-	-	-	No
Clearwater	2	4	2	-	-	For 1 area
Coeur d'Alene	1	1	-	-	1	No
Custer	3	2	-	1	2	No
Deerlodge	6	5	6	-	-	No
Flathead	2	1	2	-	-	No
Gallatin	5	2	4	-	1	For 2 areas
Helena	7	4	4	2	1	No
Kootenai	2	3	2	-	-	No
Lewis & Clark	1	1	-	1	-	No
Lolo	10	10	9	1	-	No
Nezperce	5	3	5	-	-	No
Pend Oreille	0	3	-	-	-	---
Selway	4	3	4	-	-	No
St. Joe	4	1	4	-	-	Yes
	69	66	54	9	6	

There is little need to mention the seriousness of the situation, indicated by the above data, which exists throughout the lodgepole-pine stands of Regions 1 and 4. A rather intensive survey of the Beaverhead shows the presence of 16,300,000 trees attacked in 1932. The destruction of from 70 to 90 per cent of the lodgepole-pine stands of this forest is assured. In the Bitterroot the infestation has spread northward, infesting both lodgepole pine and yellow pine. In Idaho the Nezperce and Selway Forests present a serious situation. The

Supervisor of the Nezperce writes, "Mountain-pine beetles have just about completely devastated the lodgepole stands of the forest. Practically all trees above 6" d.b.h. have been attacked and the survival of trees above this class will be very small at the end of the next growing season." The Supervisor of the Selway states that he is of the opinion that practically all of the lodgepole over 4"-6" on the forest will be taken. It is apparent that this infestation has spread northward from the Salmon and other Idaho forests of Region 4, where very severe outbreaks exist. Though the destruction of the lodgepole forests of Idaho would seem to be assured, one can not foresee the future of this infestation in its relation to the white pine forests of northern Idaho.

Two independent outbreaks of the mountain-pine beetle in stands of limber pine were reported from the Absaroka Forest, and from the Beaverhead, Bitterroot, Clearwater, Deerlodge, Gallatin, Lolo, and Nezperce Forests outbreaks in both lodgepole pine and white-bark pine were listed, but recorded as lodgepole infestations.

Infestations of the western-pine beetle in ponderosa pine were recorded from the Cabinet, Custer, Lolo, and Nezperce Forests. On the Cabinet and Custer the outbreaks were decreasing, while on the Lolo and Nezperce an increase was recorded.

Nineteen outbreaks of the Douglas fir beetle were recorded from the Absaroka (1), Bitterroot (1), Blackfeet (5), Cabinet (2), Coeur d'Alene (1), Flathead (5), Kaniksu (1), Lolo (2), Nezperce (1) Forests. Increasing outbreaks of this insect were recorded from the Blackfeet(2), Cabinet (2), Coeur d'Alene (1), Flathead (4), and Lolo (1) Forests. There is a rather general outbreak of this insect throughout the Douglas-fir forests of the region, which has already resulted in heavy losses of Douglas fir. The future of these outbreaks can not be predicted.

Reports of spruce budworm outbreaks were again received from four forests as follows: Absaroka (2), Clearwater (1), Coeur d'Alene (1), Helena (2), Nezperce (1), Selway (4). Four of these outbreaks, Absaroka (1), Clearwater (1), Coeur d'Alene (1) and Helena (1), were considered as increasing. It would seem that there has been a marked decline in the severity of these outbreaks during the past season.

There is a widespread infestation of the true-fir beetle (Scolytus ventralis Lec.) throughout the fir forests of the Northwest. This infestation has increased materially during the past few years, and is now destroying large volumes of timber, which fortunately is of a low commercial grade. No outbreaks of the pine butterfly or Douglas-fir tussock moth were received.

Glacier National Park

Severe outbreaks of the mountain-pine beetle in white pine and lodgepole pine and of the Douglas-fir beetle in Douglas fir now cover practically the entire west side of the Glacier National Park. Heavy timber losses have occurred and more will follow. On the east side of the park outbreaks of the mountain-pine beetle have been recorded from practically all of the lodgepole stands.

Yellowstone National Park

Severe infestations of the mountain-pine beetle were recorded from all of the white-bark pine areas of the park. As yet these outbreaks have not spread into the lodgepole-pine stands adjacent.

1931 FIELD SEASON

Beaverhead National Forest

An extensive survey of the Beaverhead Forest was again conducted for the purpose of following the progress of the severe epidemic of the mountain-pine beetle which is sweeping over the lodgepole-pine stands of this area. The purpose of this study is to secure a better understanding of the spread and rate of increase that can be expected from infestations of this character. Since 1928, the losses of timber resulting from the insect epidemic on this forest have increased as follows:

Year	Number trees killed
1928	321,372
1929	2,084,123
1930	3,835,958
1931	12,238,732
1932	16,300,000

Though in 1932 considerable attention was devoted to such phases of this problem as the volume of timber remaining, susceptibility of certain timber types, etc., more work is necessary and the project will be continued next season with more attention being paid to such items.

Kootenai National Forest

Control measures were conducted on four white pine areas during the spring of 1932 against outbreaks of the mountain-pine beetle. During this project 1,794 trees were treated at a cost of $5800.00. A survey of this forest during the past season shows that though a satisfactory reduction in the infestation followed the control operations, further control will be necessary on two of the areas in the spring of 1933. An expenditure of some

$4000.00 should result in a thorough clean-up of the infestation on these areas.

Coeur d'Alene National Forest

Control measures were again instituted on the Coeur d'Alene Forest in the spring and fall of 1932, in combating mountain-pine beetle outbreaks in white pine. During the spring operation 7,906 trees were treated at a cost of $41,523.00, and in the fall 2,177 trees treated at a cost of $12,993.00. A survey during the late summer showed that though for the entire forest a marked reduction in the general infestation had not occurred, on many of the areas the infestation had been so reduced that further control was considered unnecessary. In addition to the 1932 fall project some $21,000 will be needed for the treatment of some 5,252 trees in the spring of 1933. It is expected that following the 1933 operation this project can be discontinued.

Glacier National Park

A small project was conducted on the east side of the Park against an infestation of the mountain-pine beetle in the lodgepole-pine stands of the St. Mary's River drainage. This project was instituted on a purely experimental basis with the idea of treating all infested trees within the area so that a decision could be made as to the possibility of insect flights from the severe west-side infestation where control was not considered as being feasible. This area was examined in September, and though newly infested trees were recorded it was believed that sufficient infested trees had been left untreated during the spring operation to have produced the 1932 attacks. An extensive survey was then made of all lodgepole-pine stands on the east side, and a rather general infestation recorded. If control measures are considered feasible, the sum of $10,000 will be required for the treatment of the 6,900 trees as indicated by the survey.

Yellowstone Park Project

Data secured from 1931 surveys, placed the future of this large project, which since 1929 had been directed towards the protection of the scenic Yellowstone forests, in such an uncertain light, and involved such large sums of money that control was discontinued for the 1932 season. The same areas, including the Park and adjacent forests, were surveyed in 1932 and these data though indicating that there had been no marked increases in the infestation did not offer sufficient justification to change the previous decision relative to further control. It is difficult to even attempt a prediction as to the future of the infestation in this territory. However, one may be sure that if the epidemic continues in its present severity, a very large per cent of the lodgepole-pine forests within these areas will be destroyed in a very few years.

Shoshone National Forest

In the fall of 1931 control measures were instituted within the Cody Canyon of the Shoshone National Forest in combating an outbreak of the Douglas-fir beetle. These insects were working in Douglas-fir stands that

had been weakened through defoliation by the spruce budworm during the past few years. A survey conducted in August, though covering 48 per cent more territory than the 1931 fall operation, showed that a reduction of 53 per cent had followed the treatment of 12,000 which cost but $0.76 per tree. Control was again conducted in the fall of 1932 and 8,158 trees were treated at the same low cost of $0.76. Following this operation it is expected that a large per cent of the area can be eliminated from future plans of control.

Region Four Projects

Control measures were again conducted against outbreaks of the mountain-pine beetle in the lodgepole-pine stands of the Cache, Ashley, and Wasatch National Forests. The following tabulation shows the number of trees treated and funds expended during the 1932 season:

	Spring 1932		Fall 1932	
Forest	Trees Treated	Total Cost	Trees Treated	Total Cost
Cache	5,251	$11,717	717	$1,169
Ashley	766	1,810	270	571
Wasatch	27,619	15,000	9,290	15,172

The extremely low cost as shown for the spring operation on the Wasatch is due to the very heavy concentrated infestation.

Teton National Park

Control measures were carried on against a very light mountain-pine beetle infestation within the lodgepole-pine stands of the Teton National Park. Data secured from a survey made later in the season indicate that no further work is necessary in lodgepole pine, though a rather severe infestation exists in some areas of white-bark pine.

SUMMARY OF ENTOMOLOGICAL INVESTIGATIONS

As in the past, practically the entire effort of the investigative force of the Coeur d'Alene station has been devoted to the study of destructive bark beetles. These studies have been directed towards the development of more effective and economical methods of control. Through the exhaustion and elimination of many suggested superficial leads as to new methods of control these investigations have revolved themselves into sound fundamental studies of basic principles. Such items as completing phases of seasonal histories, host selection, flight and migration habits, parasites and predators, associations with other insects, thorough analyses of going control projects, etc., have all received careful attention during the past season. From such basic

studies a sound foundation is being built from which more effective and economical control methods are being developed.

During the past season confusing seasonal history phases of the mountain-pine beetle and Douglas-fir beetle have been carefully studied and clarified. The outstanding result of this study is the habit which parent adults have of emerging from the first tree attacked and subsequently attacking a second. This information emphasizes the potential danger of emerging broods, and provides a better understanding of late attacks, sources of reinfestation, as well as the so called abnormal increases which have occurred with some infestations. Caged experiments have been conducted and small emperimental control projects started with the idea of contributing towards a better understanding of the problem of host selection. A study of the relation or occurrence of parasites to the different stages of overwintering bark beetle broods was conducted. With this information it is possible that even drastic changes may be made in our present methods of control. As there would seem to be a preponderance of these beneficial insects in trees attacked during June and which overwinter as new adults, it is possible that the treatment of this class of trees may be more injurious than beneficial. Further study is necessary before this factor can be accurately weighed.

An intensive study of spotting methods as practiced on the Coeur d'Alene brought a change in crew organization and materially increased its efficiency. The data from this project have been carefully analyzed in the hope that information will be forthcoming which will permit a more efficient and effective application of control measures.

In an attempt to learn more of the flight habits of bark beetles, "Glick" airplane traps were again used during a short series of flights over the Coeur d'Alene Forest. Though no bark beetles were taken during these flights, a number of different insects were collected at varying elevations. Weather-vane traps were also placed on a number of prominent lookout peaks, and some very fine collections, including bark beetles, secured. These traps will be continued during the 1933 season in the hopes that information will be received which will be of value in planning future projects.

Tree medication was again tested with both lodgepole-pine and white-pine trees infested by the mountain-pine beetle. Though very good success was secured from these additional tests, further work is necessary with the idea of improving the technique of application before the method can be economically used.

In order to protect trees of high scenic values from attacks of bark beetles, a series of tests were conducted with a number of different chemical sprays in an effort to render such trees immune. Though some promise of success was secured, none of the chemicals proved entirely satisfactory. This project will be continued, as the protection of highly-prized lodgepole-

pine trees around summer homes, resorts, etc., now constitute a very important economical problem of Idaho and Montana.

The annual survey of the Beaverhead Forest was again conducted in 1932. From this survey such information as the rate of spread, severity of destruction, per cent and character of stand remaining after the epidemic has passed, duration of outbreaks within an area, susceptibility of different age classes, timber types, exposures, etc., is being secured. This information is contributing towards a better understanding of the flights and spread of mountain-pine beetle epidemics in lodgepole pine which must be available if future projects are to be properly planned. This survey shows the following losses for the Beaverhead Forest:

Year	Number trees killed
1928	321,372
1929	2,084,123
1930	3,835,958
1931	12,238,732
1932	16,300,000

A study has been conducted of the Oregon engraver beetle (Ips oregoni), which periodically becomes a serious destroyer of pine reproduction and small trees. An understanding of the confusing seasonal history of this insect now permits control measures to be more accurately applied.

Studies of the factors contributing to the increase or decrease of insect epidemics have received some attention. Such phases as forest fires, logging slash, windthrows, etc., have been given all possible attention, though more time should be devoted to them.

CONTROL PLANS FOR THE 1933 SEASON

Realizing that the institution of these projects depends upon appropriations which as yet have not been made available, the following work has been recommended for the spring of 1933:

Coeur d'Alene National Forest	$20,000
Kootenai National Forest	4,000
Glacier National Park	?
Teton National Park	2,000
Yellowstone National Park	7,000
Shoshone National Forest	?

CONCLUSIONS

Available data would not indicate that any marked changes have occurred in the seriousness of the bark-beetle epidemics of this region. Though some reductions have occurred in white-pine infestations, lodgepole-pine outbreaks continue with increasing seriousness. Each year these infestations have spread to new areas and the annual loss steadily increases to tremendous figures. It is difficult to depict the actual scene of devastation left in the path of these lodgepole-pine epidemics. Mountain sides, thousands upon thousands of acres are literally red with the discolored foliage of the dying trees - trees which in a few years will fall to the forest floor, leaving an inpenetrable tangle of inflammable material which will last for decades, or until swept by apparently inevitable fires. The mature lodgepole forests of Idaho and Montana are doomed to destruction; destroyed by an epidemic of such a magnitude that thoughts of artificial control are impossible. In future plans of forest protection a repetition of such depredating insect outbreaks must be prevented. The solution of our forest insect problems lies in preventing epidemics rather than suppressing them. To achieve such results, outbreaks must be recognized and reported while in their incipiency. Field officers must carry the same sense of responsibility toward their insect problems as they do towards fire, trespass, etc. Through the neglect of the so-called harmless bug tree tremendous timber losses may occur.

It is gratifying to note the increased interest on the part of forest rangers toward their forest insect problems. The reports received, though certain suggestions have been made, show satisfactory improvement and progress, and present a very clear picture of existing forest insect conditions within the Region. It is trusted that all forest officers will continue to call upon the Coeur d'Alene station for information. The station desires to be of every possible assistance to all interested parties in helping them to better understand their insect problems.

Respectfully submitted,

James C. Evenden, Entomologist.

Affirmed,

Elers Koch, Chief of Management.

ANNUAL REPORT,
FOREST INSECT FIELD STATION,
COEUR D'ALENE, IDAHO,
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COOPERATIVE CONTROL PROJECTS

Coeur d'Alene Project

The Coeur d'Alene project, instituted in 1930 against an outbreak of the mountain pine beetle (Dendroctonus monticolae Hopk.) in western white pine was continued during the 1932 season. During these three years approximately $217,000 have been spent for insect control, and it is expected that, with an additional expenditure of $20,000 inthe spring of 1933, the project can be successfully closed. On the Coeur d'Alene National Forest a stand of high grade commercial white pine of approximately 1,135,000,000 board feet has been given protection as a result of this operation. Though difficult to accurately measure the benefits which have accrued, similar epidemics in comparable stands where control was not instituted have resulted in the destruction of some 50 to 80 per cent of the total timber volume. Though the actual control work has been conducted by the Forest Service, cooperation has been extended by the Bureau of Entomology in the administration and training of personnel, inspection of the operation while under way, as well as assuming full responsibility for making annual surveys and recommendations for control.

Kootenai Project

During the 1932 season control measures were again conducted against outbreaks of the mountain pine beetle on four white pine areas on the Kootenai National Forest. One thousand seven hundred and

ninety-four trees were treated at a cost of $5,800. It will be necessary to conduct further control on two of the areas in the spring of 1933, and it is expected that following this operation further control will not be necessary in these drainages. As a direct result of an annual campaign of forest insect control during the past few years, a potentially serious outbreak of this insect which would have undoubtedly destroyed a large per cent of the white pine of this forest has been prevented. Cooperation has been extended to the Kootenai National Forest by the Bureau of Entomology in assisting in the planning and administration of the control projects as well as in making final recommendations for control.

Glacier National Park

Serious epidemics of the mountain pine beetle in white pine and lodgepole pine, and of the Douglas fir beetle in Douglas fir, exist on the west side of the Glacier National Park. So serious are these two outbreaks that all thoughts of artificial control are economically unsound. On the east side of the park there are large pure stands of lodgepole pine, and it is trusted that these valuable scenic forests can be preserved from destruction. At the present time a light infestation of the mountain pine beetle is present within these timber stands, and unless it is found that the insects are crossing from the more heavily infested areas on the west side of the park control measures will be instituted to prevent these light infestations from developing into serious epidemics. Control measures were instituted in one small drainage in the spring of 1932, and recommendations have been made for

the expenditure of some $10,000 in the hopes that severe timber losses can be prevented. Cooperation has been extended to the National Park Service in the planning, administration and supervision of control operations as well as in the training of personnel, supervision of surveys, and recommendations for control.

Teton National Park

During the 1931 field season a light infestation of the mountain pine beetle was found within the lodgepole pine stands of this park. Control measures were instituted in the spring of 1932 with very fine success, as a survey conducted during September showed practically a 100 per cent reduction. An expenditure of a few hundred dollars has been recommended for the treatment of a light infestation of the mountain pine beetle in white-bark pine during the 1933 season. Cooperation was extended to the Park Service in the training of personnel and supervision of this project, the making of necessary surveys and recommendations for control.

Region 4 Forests

Control measures were again instituted against outbreaks of the mountain pine beetle in the lodgepole pine stands of the Cache, Ashley and Wasatch National Forests. The following table shows work conducted on these forests during the 1932 season:

	Spring 1932		Fall 1932	
Forest	Trees Treated	Total Cost	Trees Treated	Total Cost
Cache	5,251	$11,717	717	$1,169
Ashley	766	1,810	270	571
Wasatch	27,619	15,000	9,290	15,172

This is the first year that control work has been conducted to any great extent on the Ashley and Wasatch National Forests, and it is expected that following the exceedingly thorough clean-up which was made that little additional work will be necessary in the future. Every possible effort has been made on the part of the Bureau of Entomology to extend assistance to the forest officers of Region 4 in the planning and administration of these projects.

Yellowstone National Park

For three seasons prior to 1932 control measures were conducted within the Targhee, Teton, Wyoming and Caribou National Forests, and in the spring of 1931 within the Yellowstone National Park, in an effort to prevent the development of a serious outbreak of the mountain pine beetle within the lodgepole pine forests of this area. In the fall of 1931 it was found that the infestation within the above mentioned areas had increased to such a magnitude as a result of insect flights from adjacent infested areas that the continuation of the project was considered an unsound procedure. Surveys were again conducted during the 1932 season to determine if conditions had changed to such an extent that the re-opening of this project would be feasible. Though no startling increases were recorded it was again recommended that no further work be done in connection with this project. The Bureau of Entomology has extended assistance to the National Forest and park officers in the training of personnel to conduct these surveys and the actual surveying of certain portions of the area.

Shoshone National Forest

In 1931 a severe outbreak of the Douglas fir beetle (Dendroctonus

pseudotsugae Hopk.) was recorded in the Douglas fir stands of the Cody Canyon, which during the past few years had been weakened through defoliation by the spruce budworm. Artificial control measures were instituted in the fall of 1931, and some 12,000 trees treated at a total cost of $0.77 per tree. As a result of the 1931 operation a reduction of 53 per cent was secured. Control measures were again instituted in the fall of 1932, and 8,158 trees were treated at approximately the same cost. During the second year of this project a much larger acreage was covered, which accounts for the rather small per cent of reduction secured. It is believed that following the 1932 operation many of the areas within this unit of infestation can be eliminated from further control plans. The Bureau of Entomology has extended extensive cooperation to the Forest Service in connection with this project. They have assumed full responsibility for the conducting of necessary surveys and the making of recommendations, and have each season detailed an officer to the project to assist in its administration and supervision.

Halsey, Nebraska, Plantation Studies

PINE TIP MOTHS AND PARASITES

Rhyacionia frustrana bushnelli (Busck): Damage by this species of pine tip moth was somewhat less than last year, due to increased parasitism, and is considerably lighter than prior to parasite introductions.

Campoplex frustranae Cushman: This parasite, introduced from Virginia in 1925 for the control of Rhyacionia frustrana bushnelli, increased the normal parasitism of about 10% to as high as 83-93% by

1929 and 1930, with considerable variation at different distances from the original point of colonization. The sudden drop in 1931 was due largely to scarcity of host material and possibly also partly to adverse winter conditions; parasitism averaged about 40% for all plots. The host showed a decided increase for the second generation of that year. The 1932 studies show the parasite recovering, parasitism increasing to an average of 48% for all plots. It appears now that Campoplex is being influenced detrimentally in certain plantations by a second species of tip moth, discussed below.

Rhyacionia neomexicana Dyar: Serious damage by this tip moth has developed within the last four years but at present it is confined largely to the northeastern part of the planted area, near the nursery. In 1932 it continued to increase, heavy damage occurring further back in the plantations. The introduced parasite apparently is unable to develop on this host. It was noticeable this year that where R. neomexicana was so abundant parasitism of the other moth was light, averaging only 19%; while several miles out where R. neomexicana was scarce parasitism of R. frustrana bushnelli averaged 62%. The larger size of the trees and somewhat lighter infestation by R. frustrana bushnelli in the area of lesser parasitism might be contributing factors but it seems very likely that Campoplex is ovipositing in the more abundant R. neomexicana from which it is not developing. Further study should furnish some valuable information on this complex parasite problem.

Parasite Colonizations: During July adults of Campoplex frustranae obtained during rearing experiments were colonized in three private plantations

outside the Nebraska National Forest; two in Holt County, and one in Thomas County near the forest boundary. The number of adults liberated at each place were 363, 289 and 211 respectively. Practically all of the private pine plantations in the Nebraska sand hill country are seriously damaged by the tip moth, Rhyacionia frustrana bushnelli. Trial shipments of adults of this parasite from Halsey, Nebraska, to Melrose Highlands, Mass., proved 87% successful and indicates a satisfactory method of handling adults.

PITCH MOTHS

Dioryctria ponderosae Dyar: Experiments this year again showed that a majority of the immature pitch moth larvae wintering in the bark of Scotch pine trees were destroyed by felling these trees during the winter months. However, it was found that a small per cent were able to mature, in midsummer, particularly in trees or piled logs left in the shade and in several instances on the under side of logs piled in the sun. No survival was possible in parts exposed to direct solar heat. Some larvae burrowed beneath the surface of the wood to escape excessive drying under the bark. These trees were all under 9 inches in diameter at the stump.

Control cutting by the Forest Service during the past winter eliminated most of the heavily infested, or brood trees in Scotch and Austrian pine plantations. Plot counts showed the infestation considerably reduced by these measures. The greater part of the trees cut were utilized for fuel, but where such trees are left in the plantations the above study indicates that to obtain a complete kill of pitch moths the bole of the tree should be placed in the open and turned at least once before the end of June to expose the under side to the sun.

Miscellaneous Projects

Other small cooperative projects have been carried on during the past season such as the examination of small infested areas on summer-home sites, privately-owned timber lands, examination of insect damage to forest products and the carrying on of extensive cooperation with various interested individuals throughout the region.

SUMMARY OF ENTOMOLOGICAL INVESTIGATIONS

As in the past, practically the entire effort of the investigative force of the Coeur d'Alene station has been devoted to the study of destructive bark beetles. These studies have been directed towards the development of more effective and economical methods of control. Through the exhaustion and elimination of many suggested superficial leads as to new methods of control these investigations have revolved themselves into sound fundamental studies of basic principles. Such items as complexing phases of seasonal histories, host selection, flight and migration habits, parasites and predators, associations with other insects, thorough analyses of going control projects, etc., have all received careful attention during the past season. From such basic studies a sound foundation is being built from which more effective and economical control methods are being developed.

During the past season confusing seasonal history phases of the mountain pine beetle and Douglas fir beetle have been carefully studied and clarified. The outstanding result of this study is the habit which parent adults have of emerging from the first tree attacked and subsequently attacking a second. This information emphasizes the potential

danger of emerging broods, and provides a better understanding of late attacks, sources of reinfestation, as well as the so called abnormal increases which have occurred with some infestations. Caged experiments have been conducted and small experimental control projects started with the idea of contributing towards a better understanding of the problem of host selection. A study of the relation or occurrence of parasites to the different stages of overwintering bark-beetle broods was conducted. With this information it is possible that even drastic changes may be made in our present methods of control. As there would seem to be a preponderance of these beneficial insects in trees attacked during June and which overwinter as new adults, it is possible that the treatment of this class of trees may be more injurious than beneficial. Further study is necessary before this factor can be accurately weighed.

An intensive study of spotting methods as practiced on the Coeur d'Alene brought a change in crew organization and materially increased its efficiency. The data from this project has been carefully analyzed in the hope that information will be forthcoming which will permit of more efficient and effective application of control measures.

In an attempt to learn more of the flight habits of bark beetles, "Glick" airplane traps were again used during a short series of flights over the Coeur d'Alene Forest. Though no bark beetles were taken during these flights, a number of different insects were collected at varying elevations. Weathervane traps were also placed on a number of prominent lookout peaks, and some very fine collections, including bark beetles, secured. The use of these traps will be continued during the 1933

season in the hopes that information will be received which will be of value in planning future projects.

Tree medication was again tested with both lodgepole pine and white pine trees infested by the mountain pine beetle. Though very good success was secured from these additional tests, further work is necessary with the idea of improving the technique of application before the method can be economically used.

In order to protect trees of high scenic values from attacks of bark beetles, a series of tests was conducted with a number of different chemical sprays in an effort to render such trees immune. Though some promise of success was secured, none of the chemicals proved entirely satisfactory. This project will be continued, as the protection of highly-prized lodgepole pine trees around summer homes, resorts, etc. now constitutes a very important economical problem of Idaho and Montana.

The annual survey of the Beaverhead Forest was again conducted in 1932. From this survey such information as the rate of spread, severity of destruction, per cent and character of stand remaining after the epidemic has passed, duration of outbreaks within an area, susceptibility of different age classes, timber types, exposures, etc. is being secured. This information is contributing towards a better understanding of the flights and spread of mountain pine beetle epidemics in lodgepole pine, which must be available if future projects are to be properly planned. This survey shows the following losses for the Beaverhead Forest:

Year	Number trees killed
1928	321,372
1929	2,084,123
1930	3,835,958
1931	12,238,732
1932	16,300,000

A study has been conducted of the Oregon engraver beetle (Ips oregoni), which periodically becomes a serious destroyer of pine reproduction and small trees. An understanding of the confusing seasonal history of this insect now permits control measures to be more accurately applied.

Studies of the factors contributing to the increase or decrease of insect epidemics have received some attention. Such phases as forest fires, logging slash, windthrows, etc. have been given all possible attention, though more time should be devoted to them.

STATION PERSONNEL - CALENDAR YEAR 1932

Permanent Personnel

James C. Evenden, Entomologist
Archie L. Gibson, Assistant Entomologist
L. G. Baumhofer, Assistant Entomologist
Wm. Dellos Bedard, Assistant Entomologist
Henry J. Rust, Senior Scientific Aid
T. T. Terrell, Assistant Scientific Aid
Laura B. English, Clerk-Stenographer

Temporary Personnel under Bureau Appointment

Mildred A. Hemenway, Junior Clerk-Stenographer
(Nov. 9, 1931 to May 8 inc., 1932)

Elmer E. Miller, Assistant Field Aide
(June 3 to Dec. 31 inc., 1932)

Francis B. Foley, Assistant Field Aide
(June 10 to Dec. 9 inc., 1932)

Jerome Dahl, Assistant Field Aide
(June 13 to Nov. 5 inc., 1932)

Employees Hired under Letter of Authorization

Adam Cherney
(Sept. 19-23 & 26 to 30 inc.; Oct. 1 & 3-7 inc.)

Earl Ritzheimer
(Aug. 31 to Sept. 27 inc.)

Respectfully submitted,

James C. Evenden

James C. Evenden
Entomologist

UNPUBLISHED
SURVEY & CONTROL
REPORTS

INTERMOUNTAIN STATION
Central Reference File
No. 3.4163-52

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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

THE SECOND BATTLE OF THE BIG HOLE BASIN

By

James C. Evenden, Associate Entomologist
Forest Insect Field Station, Bureau of Entomology
Coeur d'Alene, Idaho.

February 1, 1928.

U. S. GOVERNMENT PRINTING OFFICE: 1928 J 76123

Corrected Copy

THE SECOND BATTLE OF THE BIG HOLE BASIN

By

James C. Evenden, Associate Entomologist,

In Charge of the Forest Insect Field Station, Bureau of Entomology,

Coeur d'Alene, Idaho.

February 1, 1928.

SECOND BATTLE OF THE BIG HOLE BASIN

Western histories tell us of the battle of the Big Hole Basin. From these books we learn that this engagement was between the Nez Perce Indians and forces of the United States Army, and occurred on August 9, 1877. The site of this battle, which lies some twelve miles west of Wisdom, Montana, is marked by a national monument, and there the casually interested tourist, as he travels over the park-to-park highway, may read a brief history of this battle, examine the big gun which was captured by the Indians and then abandoned, and, if his observation is keen, note the six-inch lodgepole pine trees growing within the hastily-constructed entrenchments. We learn that during the summer of that year the Indians under command of Chief Joseph left their reservation at Lapwai, Idaho, and, after engaging in several battles with settlers and United States troops, travelled eastward with their families over the mountains towards the buffalo country. At daybreak on the morning of August 9 a command of United States cavalry under the leadership of General Gibbons attacked the Indians while in their camp on the Big Hole River. During the battle, which lasted throughout the day, both sides suffered heavy casualties, but at night a majority of the Indians, after burying their dead, withdrew to follow their families who had stolen away during the day. By the night of August 10 all

the Indians had withdrawn and the battle was over. Relief for the soldiers arrived from Deer Lodge, Montana, and after the wounded had been cared for and the dead buried another page of American history had been made and closed.

During the summer of 1927, which marked the fiftieth anniversary of the Battle of the Big Hole, a second battle of an entirely different nature was launched from the same site as the 1877 engagement. This battle was waged against an army of insects which for years had been moving southward along the Continental Divide, leaving in their wake a devastated forest of lodgepole pine and yellow pine.⊗ The components of this army were small, black, cylindrical bark beetles about one-fifth of an inch in length, known to the forester as the mountain pine beetle (Dendroctonus monticolae). Their objective seemed to be the destruction of the lodgepole pine forests of Montana, and thousands upon thousands of healthy mature trees have been thus destroyed in the past. The strength of this army can be visualized if one realizes that approximately 2,200 beetles are required to kill a lodgepole pine tree of average size. The attacking insects bore through the bark and construct long perpendicular galleries which are directly between the bark and the wood. At regular intervals along these galleries eggs are deposited which soon hatch into small grubs or larvae. These white, legless grubs excavate, at right angles to the egg galleries, short larval mines that also lie between the bark and the wood. Transformation

⊗ For a history of this insect infestation the attention of the reader is invited to an article in the October, 1925, issue of American Forests and Forest Life entitled "The Beetles Beat the Pines."

from the mature larvae to the adult beetles occurs within small cells at the end of the larval mines. There is but one generation of these insects in a season. The adult beetles emerge during July and August ready for the advance and an attack upon living, healthy trees. The egg galleries and larval mines result in the complete girdling of the tree, causing its death as surely as though it had been chopped by the lumberman's axe.

To check the advance of this invasion it became necessary for the Department of Agriculture to institute defensive control measures to protect the valuable timber stands which lay in its path. The plan of defense, or control, called for the utilization of the Big Hole Basin as a zone of defense. This zone lies across the path of the invasion and all of the infested trees within it were to be treated each year or until such a time as reinfestation no longer occurred. To supervise this operation, which was directed by the Bureau of Entomology and conducted by the Forest Service, a force of forest officers was gathered to take charge of the many treating and spotting crews required. In considering the problem of bark beetle control, it must be remembered that when a tree is once successfully attacked it is impossible to save it. However, the broods which lie beneath the bark may be destroyed and the subsequent attack on adjacent trees prevented.

The first step in this plan of control is the location of the infested trees for treatment, which is accomplished by making a 100

per cent survey of the infested area with what are called spotting crews. These infested trees are detected through the presence of little pitch tubes which form at the mouths of the entrance tunnels of the attacking beetles or through the presence of fine boring dust around the base of the tree. A map showing the location of the various groups of infested trees is made by the chief spotter and those which require treatment are marked with a white cloth tag. The spotting crews usually consist of five men, of which one is the compassman, or chief of party, who is charged with the supervision of the crew. Each spotter covers a strip one chain in width parallel with and adjacent to the course of the compassman, on which practically all of the infested trees are located for subsequent treatment.

Treating crews follow rather closely upon the spotters and, with the aid of the accurately constructed maps, the crew foreman easily relocates the trees tagged for treatment. The trees are then felled and the infested length is cut into logs which are skidded into decks with the aid of a horse, and burned. Brush resulting from this operation is placed on top of the decks and destroyed. Stumps are cut low so that all the infested portion of the log is included in the treatment, and as these decks usually burn clean all that remains from this work are the stumps and ashes. Under favorable weather conditions, and when there is no danger of injury to adjacent uninfested trees, the large, heavily-limbed trees, which are the most expensive to treat by the felling and burning method, are often treated by fire while standing. This is accomplished by piling

around the base of the tree brush and tall poles which carry the flames up the bole, scorching the bark sufficiently to kill the broods beneath.

If this narrative is continued in military parlance, then the operation of 1927 was but the first real skirmish of the battle to follow. A few miles to the northwest and across the Continental Divide, within the drainage basin of the Bitterroot River, there lies, in an area containing hundreds of thousands of infested trees, and now called the main body of the infestation, a tremendous number of enemy reinforcements. Each year these reinforcements or reserves move forward and as a result each year a larger number of trees are infested within the zone of defense. A year, two years, or even more, may pass before the main body of this insect army will sweep into the Big Hole Basin. If the area is to be held against this advance, it will be necessary that all of the infested trees within the zone of defense be treated each year. This action will no doubt be feasible, but the real battle -- the test of the strength of the men and dollars mustered together to stem the advance of this insect enemy -- will occur when the main body of this insect army sweeps into the area, thus infesting thousands of trees where hundreds had previously been attacked. Should the Government forces be successful in this battle then another advance will have been made in the constantly increasing warfare against our insect pests, which are often said to be man's most formidable enemy. If success be attained the forests, valuable for commercial and aesthetic reasons, which lie in the southern path of this destructive insect horde

will be saved. With failure these destructive forces will press forward, leaving in their wake a devastated forest -- a fire menace -- which will inevitably court the arrival of the Red Demon to destroy those trees left by the insects, and only smoking, blackened hills, devoid of vegetation, will then remain. Time alone will tell whether success shall crown our efforts in this step of the warfare against insects which scientists predict man must soon resolutely face in order to maintain his supremacy on the earth.

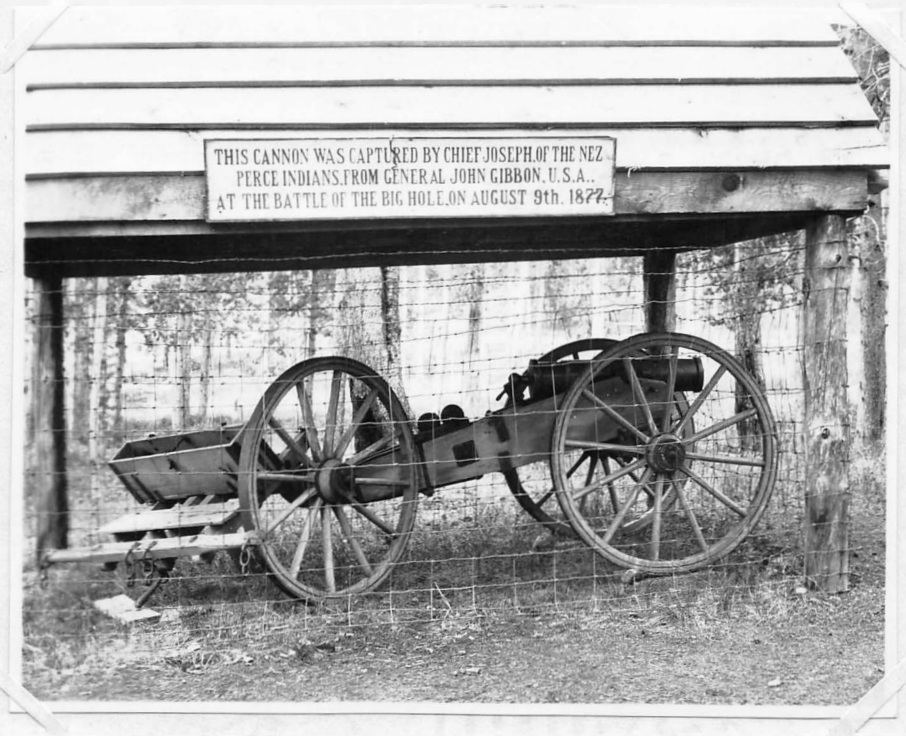
The operation of 1927, in which some 17,000 trees were treated, was but the first real encounter of the battle to follow. A few miles to the northwest and across the Continental Divide within the drainage basin of the Bitterroot River, in an area containing hundreds of thousands of infested trees, and now called the main body of the infestation, a tremendous number of enemy reinforcements existed. As an apparent insurance to the success of the Bitterroot attack, an outbreak of these insects within the Salmon National Forest, some 60 miles to the south, developed into a serious epidemic during the 1927 season, and advanced against the southern portion of the zone of defense.

Regardless of the firm foothold which the attacking insects from the Bitterroot gained within the Big Hole Basin during the summer of 1927, a still stronger counter offensive was launched by the Government forces in 1928, and over 55,000 trees were treated at a cost of nearly $100,000. Regardless of this very thorough clean-up, during the summer of 1928 the insects again swept across the Continental Divide, infesting hundreds of thousands of trees throughout the entire Beaverhead National Forest. This infestation came from the Salmon, as well as the Bitterroot, which placed the present zone of defense in an untenable position. Furthermore, it was realized that as the main bodies of these two attacking armies mov

nearer to the crest of the Continental Divide, the advance into the Beaverhead Forest would become heavier each year, and in a few years the full force of the combined attacks will be felt. Confronted with the tremendous expense necessary for the continuation of this project, for at least $500,000 would be required for 1929 alone, and the fact that no assurance of success could be given, resulted in a combined decision on the part of the Bureau of Entomology and the Forest Service that the continuation of the present plans of defense would be hopeless and useless, and a temporary victory was granted to the insects.

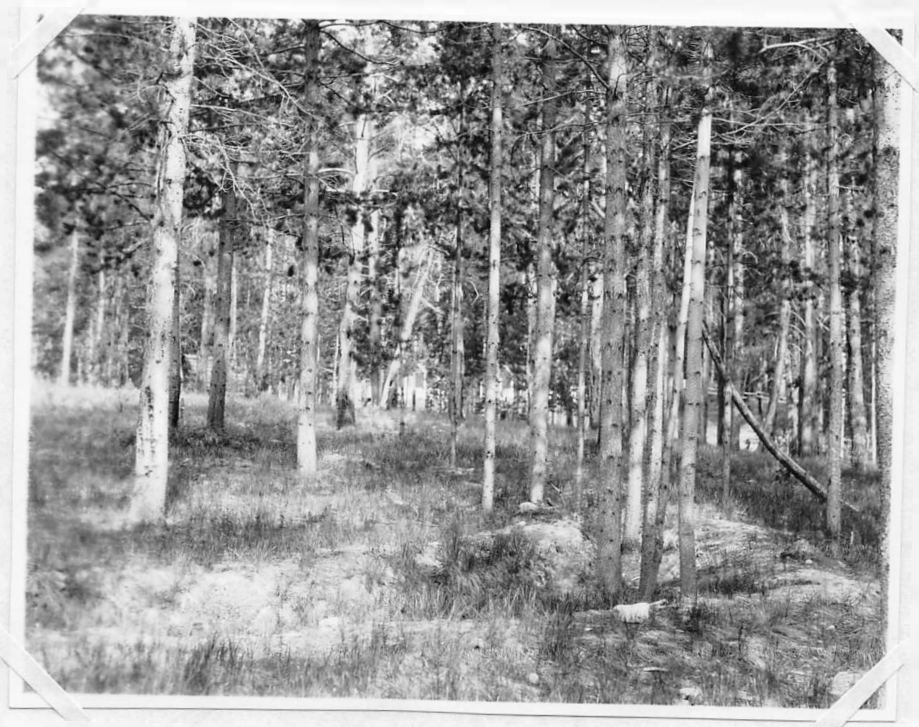
The granting of a temporary victory to the insects necessitated the development of a new plan of defense by the Government forces. The rather wide strip of open country lying between the Beaverhead Forest and the timber stands to the south will be utilized in an attempt to check further southern spread of these epidemics, and an effort will be made to prevent the insects from establishing themselves to the south of this possible or partial barrier.

Though the present battle has been lost to the insect armies, there will be no letting down in the prosecution of this warfare, and every effort will be made to protect the valuable bodies of lodgepole to the south. Should the Government forces be successful in the battle, then another advance will have been made in the constantly increasing warfare against our insect pests. With failure these destructive forces will press forward, leaving in their wake a devastated forest -- a fire menace -- which will inevitably court the arrival of the Red Demon.


THIS CANNON WAS CAPTURED BY CHIEF JOSEPH OF THE NEZ
PERCE INDIANS FROM GENERAL JOHN GIBBON, U.S.A.,
AT THE BATTLE OF THE BIG HOLE ON AUGUST 9th. 1877.

THE BIG GUN

During the Battle of the Big Hole this cannon was captured by the Indians and later abandoned as they withdrew from the engagement.



THE BIG HOLE BATTLEFIELD

There are six-inch lodgepole pine trees growing from the entrenchments dug by the soldiers. Some of the older trees that were silent witnesses to this battle have recently been killed by bark beetles.

THE INFESTED LOGS ARE DECKED

The logs are skidded into openings with a horse and then piled in large decks. Whenever possible these decks are built against infested trees, which are scorched sufficiently to kill the insects beneath the bark. The tree to the left of the deck has been tagged for treatment.

THE ENEMY IS DESTROYED

The Red Enemy of the forest is used in control. After the logs are piled the decks are fired. The brush is placed on the decks or in separate piles and burned.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

HISTORY OF YELLOWSTONE PARK BARKBEETLE CONTROL PROJECT

by
James C. Evenden
Entomologist

Forest Insect Field Station
Coeur d'Alene, Idaho
October 29, 1931

U. S. GOVERNMENT PRINTING OFFICE: 1928 J 76133

(Mr. Koch says to have these loose in front of "History of Yellowstone Park Bark Beetle Control Project" Oct. 29, 1931)

SHEEP CANYON AND BLACKTAIL CREEK UNITS
BEAVERHEAD NATIONAL FOREST

Area	Acreage Covered by 1931 Control	Infested Trees Treated 1930		1931 Survey: Acreage Covered	Acres of Strip	Infested Trees on Strip	Infested Trees per Acre	Total Infested Trees	Funds for 1932 Control
Sheep Canyon	2,345	2764	L.P.P.	15,360	590	889	1.51	23,183	
		341	W.B.P.						
		3105							
West Fork Black Tail Creek	1,700	70	L.P.P.	21,760	817	120	.147	3,200	
		288	W.B.P.						
		358							
Middle Fork Black Tail Creek	830	48	L.P.P.	7,040	165	8	.048	350	
		148	W.B.P.						
		196							
East Fork Black Tail Creek	645	31	L.P.P.	21,440	524	50	.095	2,050	
		176	W.B.P.						
		207							
Clover-Wolverine West and Middle Creeks	6,915	700	L.P.P.	7,680	224	40	.178	1,375	
		347	W.B.P.						
		1047							

Per cent of each area covered by survey varies from 2.3% to 3.8%. The large acreage surveyed is explained as follows: The timber stands within these units lie in small scattered patches of unknown acreage. In the execution of this survey it was necessary to block all of these patches into a unit of a known acreage, which in turn was covered by the survey. As a result, the data as given show not only a very light infestation scattered over a large acreage but a marked difference in the size of the areas covered by control and those surveyed. These data are very misleading, as in reality the infestation is confined to practically the same acreage as treated last spring, with a much heavier infestation than indicated. It is regretted that the above data do not separate the two tree species attacked.

RUBY & WEST FORK MADISON UNITS

Area	Acreage Covered by Control 1931	Infested Trees Treated 1931	1931 Survey			
			Sub Units	Infested Trees	Control Recommended	Fund Required
Ruby Unit	1,245	402 L.P.P.	1	0	---	
West Fork Madison Unit	1,424	380 L.P.P. 217 W.B.P.	2	1,500	300 trees Yes	$700
			3	60	Yes	120
			4	20	Yes	60
			5	300	Yes	600
			6	200	Yes	400
	2,669	999		2,080		$1,880

GALLATIN FOREST 1931 INFESTATION

MOUNTAIN PINE BEETLE

Area	Acres	1931 Infestation Per Acre L.P.P.	1931 Infestation Per Acre W.B.P.	Total 1931 Infestation L.P.P.	Total 1931 Infestation W.B.P.	Total 1931 Infestation Total	Funds Required for 1932 Control	Cost Per Tree
Monument Mt. T. 10 S., R. 5 E.	10,240		.174		1782	1782	$ 4,009	$2.25
Tepee Creek T. 11 S., R. 4 & 5 E.	10,240	.066	.127	676	1300	1976	4,446	2.25
Denny Creek T. 13 S., R. 4 E.	3,200	.007	.136	22	435	457	1,028	2.25
Beaver Creek T. 10 S., R. 3 E.	6,400	.007	.160	46	1022	1068	2,403	2.25
Moose Creek T. 10 S., R. 2 E.	640		.850		544	544	1,224	2.25
Placer Creek T. 4 & 5 S., R. 2 E.	2,560	.105		269		469*	703	1.50
Mill Creek T. 9 S., R. 7 E.	2,560	.142		361		361	541	1.50
				1374	5083	6657	$14,354	

* Includes 200 fire scorched trees around Placer Creek fire.

SUMMARY OF YELLOWSTONE PARK PROJECT

Forest	1929			1930			1931			1932		
	Acres	Trees	Funds	Acres	Trees	Funds	Acres	Trees	Funds	Acres	Trees	Funds
Beaverhead							16,234	5,870	22,976	15,104	32,030	65,000
Gallatin										35,840	6,557	14,354
Yellowstone							12,344	2,888	7,767	117,826	43,999	110,000
Targhee	14,800	31,204	16,469	67,948	30,064	28,449	102,670	32,316	42,571	438,000	119,874	165,000
Teton		651		4,000	4,515	3,062	4,500	4,762	6,717		1,400	4,601
Wyoming		6,945	4,834	60,800	17,160	23,509	105,000	17,055	57,645	48,339	11,993	44,510
Caribou		386		3,240	4,593	2,981	14,980	11,539	16,558	24,000	11,241	21,000
Cache		7,906	2,699	23,250	17,158	9,234	34,000	9,150	7,332	84,955	4,423	6,394
Totals		47,092	24,006		73,490	67,235		83,580	161,566		231,487	430,841

(Mr. Koch says to leave this loose in front of "History of Yellowstone Park Bark Beetle Control Project - Oct. 29, 1931)

REPORT OF THE SURVEY OF THE GALLATIN NATIONAL FOREST TO DETERMINE THE STATUS OF THE MOUNTAIN PINE BEETLE - 1931

The object of the 1931 barkbeetle survey on the Gallatin Forest was to determine the status of the mountain pine beetle on the Forest. An extensive survey was to be made of the Forest unless areas showing a concentration of beetle work were discovered, in which case a sufficiently intensive survey was to be made to secure an indication of the infestation present.

The survey indicates that the infestation over most of the Forest is quite light, averaging for the entire area less than .02 trees per acre. Concentration of attack was noted on a few areas, and the data for them has been arranged in Table I. Designations of areas are by township and range. A more intensive survey of these areas was desirable, but impossible under the prevailing weather conditions and the short time available.

Park Ranger Johnston found considerable mountain pine beetle infestation in the north and northwestern part of the Yellowstone Park. On the basis of his verbal report, a more intensive survey was made of the areas adjoining the Park on the north and west. Both the Yellowstone Park and the present survey found the greatest infestation in the white bark pine type and only a very light infestation in general in lodgepole pine. The infestation in white bark pine is not a new one, the numerous red-tops indicating it has been active for a number of years, although not killing annually as many trees as during the present season.

A peculiarity of the infestation is that even in the mixed lodgepole - white bark pine type the mountain pine beetle seems to prefer white bark pine, and with one exception no really active centers of attack on lodgepole pine were noted. The one exception was around the fire line and in the zone of damage by the Placer Creek fire, where scorched lodgepole pine and white bark pine both contain mountain pine beetle brood. Small groups of attacked lodgepole pine were also noted within a radius of a mile of the fire.

For the entire forest a total of about 580 miles of strip one chain broad indicates about 16,000 attacked trees, based on an average of .019 trees per acre. Of the 240 attacked trees noted, 105 were lodgepole pine and 135 white bark pine. Of the total strip obtained, about 300 miles were run in lodgepole pine type and about 70 in white bark pine. This ratio of types does not indicate the ratio present on the forest. There is probably a larger ratio of white bark pine but much of it is inaccessible at this time of the year.

In T. 11 S., R. 5 E., a heavy infestation, probably of the Engelmann spruce beetle, is present in Engelmann spruce. On 106.9 acres, 83 attacked spruce were observed, giving an average of .776 trees per acre.

Destruction of scattered lodgepole pine by the lodgepole pine beetle is general over the entire forest, but in no place is the damage heavy.

A map of the area, showing the plotted strips of the survey, accompanies this report. The original data and summary sheets are also enclosed.

Respectfully submitted,

/s/ Archie L. Gibson

Assistant Entomologist

HISTORY OF YELLOWSTONE PARK

BARKBEETLE CONTROL PROJECT

INTRODUCTION

This memorandum has been prepared for the purpose of presenting to all interested agencies in attendance at the Denver Insect Control Conferences, called for the evening of November 2nd, 1931, a brief history of the "Yellowstone Park Barkbeetle Control Project." It is believed that from such a history the seriousness of the present situation, as well as the difficulties of control, can be more fully visualized. As all steps in the history of this project, which started in 1926, are covered by individual reports, tedious details have been omitted from this paper and only a brief discussion relative to the progress of the infestation and the work which has been done to combat it are included. It is trusted that in this desire for brevity essential facts have not been omitted.

Perhaps a word of explanation as to the writer's selection of the title "Yellowstone Park Barkbeetle Control Project" is necessary. Though in the past all steps of this project which started in 1926 have been considered under local names, it would seem best at this time, inasmuch as the protection of the scenic value of the Yellowstone is their primary objective, to consider them under the one title as given.

Statements have been made in past reports, and of a necessity repeated in this paper, relative to the flight habits of the mountain pine beetle. It is recognized that the position which the Bureau of Entomology has taken on this matter is, and always will be, a difficult one to prove. The workers

of the Bureau have satisfied themselves, to a point where they sincerely believe that a shadow of a doubt no longer exists, that some epidemics of the mountain pine beetle in lodgepole have spread over large areas as a result of both long and short flights. Forecasts as to the spread of an outbreak can not be made, nor can it be said as to how far or in what direction the insects from a definite area will fly if a flight occurs. It is known, however, that mountain pine beetle outbreaks which are allowed to develop into heavy blocks of infestation constitute a serious potential menace to timber stands not only immediately adjacent but some distance removed. The position which the Bureau of Entomology advances on this matter of insect flight is not a mere theory. It is based upon the study of existing epidemics over a period of years. Data from these studies, together with many observations of existing conditions, clearly demonstrate to all those familiar with the situation the soundness of the principle. This matter, somewhat apart from the history of this project, has been mentioned, as the following analysis of past situations, as well as the future success of the Yellowstone project, depends entirely upon the flight habits of the insects concerned.

EARLY HISTORY

Late in 1911 an outbreak of the mountain pine beetle in the Big Hole Basin was brought to the attention of the Forest Service. During the seasons of 1912 and 1913, some 25,000 trees were treated. This work was apparently very successful, for from that time until 1926 no further records of losses were recorded. Furthermore, when work was resumed within this same area in 1926, to check the spreading Bitterroot outbreak, there were

no indications of depredation following the 1913 project.

Prior to this time an outbreak of the same insect in the white pine and lodgepole pine stands of the Flathead National Forest was reported in 1909. In 1912, control work was instituted and some 28,000 infested trees were treated at Swan Lake. However, it is apparent that this outbreak was far more widespread than was assumed by those in charge, and that the control operation was confined to a small area. In attempting to analyze this situation it would seem that the control work was confined to the heavy centers and that the outlying groups were allowed to spread southward across the rather lower divide between the Flathead and the Missoula National Forests. The devastation and fire hazard created by this outbreak within the northern portion of the Missoula is still mute evidence of its seriousness. With the advent of this infestation into the northern portion of the Missoula National Forest, it was, in a measure, officially forgotten, as the life and potential spread of such an outbreak was not foreseen.

MORE MODERN HISTORY

During the winter of 1924 it became known to the Regional Office that there were a number of lodgepole pine trees being killed by the mountain pine beetle in the southern portion of the Missoula National Forest in the vicinity of Philipsburg. This area, though over one hundred miles to the south of where control work was instituted at Swan Lake in 1912, could be connected through successive steps of the epidemic. As vast timber stands of aesthetic and commercial values lay directly in the southern path of the Philipsburg infestation, the situation was considered as justifying action. Without the advantage of any survey, this infestation was considered as constituting the

head of the spreading infestation from the north. The Philipsburg basin was adopted as a "No bug's land," and plans formulated to treat all of the infested trees to the south of this area. In late May and June, 1924, with the few hundred dollars available, 1010 trees were treated by a small mobile crew.

In the summer of 1924, an extensive survey was made of not only that portion of the Missoula Forest covered by control, but of the adjacent portions of the Bitterroot, Beaverhead, and Deerlodge Forests. The results of this survey were more than discouraging, as it was found that not only had areas been missed by the feeble control of the previous spring, but that on the head of the east fork of the Bitterroot River there were heavy centers of infestations, with thousands of trees harboring the 1925 attacks of the mountain pine beetle. As at that time bark beetle control was not considered in the same magnitude as at this time, thoughts of continuing the project were abandoned, though its seriousness was not underestimated.

Late in the winter of 1924 and 1925, a few thousand dollars available from the insect control allotment were offered to Region One, to combat the existing Bitterroot infestation. These moneys were accepted, and in a hastily conceived plan of control all infested trees to the south of an imaginary line, consisting of small streams, drainages, and divides, were treated, with no recognition of the ability of these insects to fly even short distances. The following summer the inevitable occurred, and with a hop, skip, and a short jump, the beetles spread across this line of defense, infesting ten trees where one had been previously treated.

A survey conducted during the summer of 1925 showed that there were now some rather large groups of 1925 attacks on the west side of the Big

Hole Basin, where in 1924 there were only a very few small spots of infestation. With a still further attempt to check the spread of this outbreak into the Beaverhead Forest and areas to the south, plans were instituted for the treatment of the infested trees within the Big Hole Basin in the spring of 1926. Another attempt was also made at that time to check the infestation on the east fork of the Bitterroot River from spreading into the valuable yellow pine stands of the west fork. Though some hope was held out for the holding of the Big Hole Basin, with the expectation that the Continental Divide would act as a partial barrier to the spread of the insects, very little chances of success were offered for the Bitterroot campaign.

A more intensive survey conducted during the summer of 1926 showed the fallacy of continuing the Bitterroot project, and also demonstrated that there had been a heavy flight of beetles across the Continental Divide, reinfesting the areas within the Big Hole Basin which had been thoroughly covered by control the previous spring. In the execution of the 1926 survey the writer overlooked, or rather underestimated, the flight potentials of these insects, for not only did they cross the divide into the treated portions of the west side of the basin, but small spots of infestation crossed the timberless areas and became established on the east side of the Basin. The possibilities of such an occurrence were not entirely overlooked, but the survey of the east side consisted of a red top reconnaissance only, and of course the new attacks (1926) did not show at that time.

Still hoping that the Big Hole Basin might be held against the spread from the Bitterroot, a much larger area on the west side of the

Big Hole Basin was once more thoroughly covered by control in 1927. Again the results of the fall survey were discouraging. Not only were the areas thoroughly covered by control reinfested to a degree heavier than that treated, but all portions of the Big Hole Basin now contained heavy infestations.

At this time a new element of danger was recognized, and must be recorded in this history. With its source an item of conjecture, an outbreak of the mountain pine beetle in the lodgepole pine forest of the Salmon National Forest reached in 1927 a serious epidemic status. This outbreak caused the existing Big Hole project to be viewed in a more precarious light. The Salmon Forest borders the Beaverhead Forest, and large blocks of infestation just over the Continental Divide from the Big Hole Basin were considered as constituting a new source of reinfestation to the areas being covered by control. In fact, it was sincerely believed that these centers of infestation on the Salmon had already contributed to the scattered infestation which occurred in the southern portion of the Big Hole Basin in 1927.

In considering the devastation that would occur to both commercial and scenic properties if this epidemic continued its southern spread, control work was again instituted in 1928, on the largest scale ever before undertaken, in a rather forlorn hope that the Big Hole Basin might be held. However, the reinfestation which occurred during the summer of 1928 within the areas previously covered by control clearly demonstrated the folly of attempting to continue this project in its present form, and no further work was recommended for the Big Hole Basin. In explanation of this position the following

is offered. In 1928, there were 60,000 acres covered by control, with an expenditure of $89,000. The 1928 reinfestation of this area alone was so severe that to have treated this same acreage in 1929 at least $350,000 would have been required, and it was shown by the survey that there were some 500,000 additional acres that were lightly infested but which would need be considered in all future plans of control. Because of the physical and financial difficulties of such a project, as well as the fact that no hope of success could any longer be held, the present project was discontinued. However, in full recognition of the seriousness of the situation, every effort was to be made to prevent the insects from becoming established within the Madison Forest, which was separated from the Beaverhead with some rather wide timberless areas.

At this time the writer desires to break briefly into the discussion of the history of this project to mention the value of adequate surveys following all control projects. The Big Hole survey of 1928 was the first time that a worth while reconnaissance had been made of this project, and its worth has been proven many times over. Without the data secured from this survey it is possible that the project might have been continued, and that large sums of money might have been foolishly spent in attempting to stem the spread of the Bitterroot and Salmon infestations into the Big Hole Basin, while the insects had already crossed the so called barrier and were established miles away. The institution of a project without complete information as to the status of the infestation within adjacent areas, though sometimes necessary because of the time element often involved, should always be avoided when possible. But the continuation of a project without these data can not be justified on any grounds, and inevitably leads to useless expenditure of public funds.

Nothing more was done with the Beaverhead infestation until during the summer of 1930 small spots of infested trees were discovered scattered throughout the western portion of the Madison National Forest. At the same time the annual survey of the Beaverhead National Forest which is now being conducted by the Bureau of Entomology disclosed the fact that the timbered area known as the Sheep Creek Canyon, lying between the Beaverhead and Madison Forests, was rather heavily infested. In the spring of 1931 control measures were instituted, and all of the infested areas within the Madison as well as the Sheep Creek Canyon were thoroughly treated. This brings the discussion of the Montana portion of this project up to the 1931 survey, which will be handled under the "Present Status of the Infestation."

At this time it is necessary to go back to the year 1928, for in that year infestations of the mountain pine beetle were discovered within the Targhee National Forest. This Forest borders the Yellowstone Park to the southwest, and the infestation constituted a serious potential menace to the scenic timber stands of the Yellowstone. The known infestations within the Targhee were treated in the spring of 1928, but a survey conducted during the following summer showed that the outbreak was far more widespread than had been anticipated, and was also present within the Teton, Caribou, Wyoming and Cache Forests. In the spring of 1929, control work was extended to these Forests, and again all known infested areas were covered by control. During the following summer a survey of these Forests again disclosed the fact that, with the exception of the Targhee, where the number 30,000 remained about the same, there had been a marked increase in the number of infested trees. New areas of infestation were also uncovered by this survey. Control work was again conducted on these Forests in 1930, and followed by

surveys during the summer. Some success was attained by this work, and substantial reduction in the amount of reinfestation on the Targhee, Teton, and Cache were shown by the surveys, but marked increases in the Wyoming and Caribou. A few new areas of infestation were also discovered by the 1930 survey and fall control work. Late in the fall it was found that infestation was then present in the southwest corner of the Park, and plans were made to treat the infested trees the following spring.

In 1931, these Forests, as well as the known infested areas of the Yellowstone, were once more covered by control, and every effort made to make the work as thorough and effective as possible. Thorough clean-ups were called for, and stress placed upon the importance of locating and treating all infested trees.

It would seem that a brief discussion of the infestation existing in the Targhee, Teton, Wyoming, Caribou and Cache National Forests might be of interest, and would serve to more clearly depict the present situation. The inception of this rather widespread outbreak, which was first recorded in 1928, is unknown. Infestations develop locally, and it is possible, and very likely probable, that the outbreak on these five Forests developed from existing normal or endemic infestations. With our present realization of flight potentials of insects when carried by strong air currents, a flight of beetles from the more heavily infested areas to the northwest is perhaps not an impossibility. The fact that these outbreaks occurred as a rather progressive step in the Montana epidemic and even the Salmon Forest outbreak might lend some argument to the flight possibility. The writer has no definite opinions on this matter aside from the fact that both solutions are possible, with the greater emphasis being placed upon the first. It is

a matter which can never be definitely proven so need not be discussed further at this time. However, regardless of the source of the reinfestation which has occurred on the treated areas it is a problem which has a direct bearing upon the future of this project and must be seriously considered. The writer desires to quote from his report of the Targhee project for the season of 1930:

"it is obvious that there are but two ways to account for this unexpected reinfestation that has occurred within the areas covered by control. Either there was sufficient bark surface left untreated within these areas to account for the 1930 infestation, or else insects are flying into the areas. Such untreated bark surface could have existed in trees missed during the operation and through the inadequate treatment of infested trees. In considering the possibilities of missed trees, thought must be given to the one sided attack of trees where a normal brood is produced from the sided attack, but the uninfested side passed by the spotter and the tree considered as being uninfested. Flights of insects would of necessity be coming from the severe epidemics of this insect within the Forests to the north, or else from the untreated areas adjacent to the control units."

The writer can see no reason to change this analysis. It is a mooted question, one that has entered seriously into the problem, and one which to a large extent will measure the success of our efforts to protect the Forests of the Yellowstone. To try and throw more light upon this question, the 1931 control operations were instituted on the basis of a 100 per cent clean-up. Through the adoption of such a policy it was thought that if the treated areas again showed a heavy 1931 reinfestation one would of

a necessity feel that insects were flying into the area. From the results of the 1931 survey it is hoped that a more definite position can be taken on this rather vital issue.

This discussion brings the history of the "Yellowstone Park Bark-beetle Project" up to the situation as exists in the fall of 1931. It is doubted if all of the necessary data will be available to the writer in time to include the present status of the infestation within this paper. However, in the following tabulation, which shows in a trifle more detail the steps mentioned in this history, all 1931 data available will be included:

TABULATED FINANCIAL HISTORY OF PROJECT

Early Work Perhaps not a part of Project

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Swan Lake Project - Flathead National Forest

Year	Acreage	Trees Treated	Cost per Tree	Total Cost	Remarks
1913	3,240	28,000	$ 0.22	$6,350	Trees were felled in windrows and burned. Apparently only large groups. No spotting cost, etc.

Big Hole Basin - Beaverhead National Forest

1912	10,000	2,426	0.72	1,750	Trees treated standing. Lower 6-12 feet peeled. No spotting charges.
1913	60,000	23,393	.33	7,789	" " " "

Late Work - Part of Yellowstone Park Project
Bitterroot National Forest

1925	5,960	7,725	.87	6,735	Trees treated standing. Lower 6-12 feet of bole peeled. No spotting charges
1926	7,000	1,244	3.89	4,832	Trees felled and peeled.

Big Hole Basin - Beaverhead National Forest

1926	17,920	5,271	2.27	11,984	Trees felled. Infested portion of bole placed in decks and burned. 100% spotting
1927	18,588	17,418	1.80	31,500	" " " "
1928	299,520	55,045	1.62	89,289	" " " "

Targhee National Forest

Year	Acreage	Trees Treated	Cost per Tree	Total Cost	Remarks
1928	5.000	2,752	.64	$ 1,766.00	Trees burned standing by spraying oil on bole
1929	14,800	31,204	.53	16,469.34	Same method. Better job of burning; more oil used. Comb. spotting and treating crews
1930	67,948	30,064	.95	28,449.00	Same method. More oil used and larger area covered. Scattered infestation.
1931	102.870	Fall 1930-3,671 Spring 1931-32-316	1.31	2,247.00 42.517.77	Fall control Spring control 18% Felled for treatment
Estimated 1932	438.000	119.874	1.31 ?	157.000?	

Teton National Forest

1929		651			Trees burned standing with oil
1930	4,000	4,515	.68	3,062	
1931	4,500	4,762	1.41	6,717	38 per cent of trees felled for treatment. 62 per cent burned standing.
Estimated 1932		1,400		4601	

Wyoming National Forest

1929		6,945	.69	4,834	Trees burned standing with oil. Some felled for treatment.
1930	60,800	17,160	1.37	23,509	Trees burned standing with oil. A few felled.
1931	105,000	17,055	3.37	57,645	Rather a large per cent of trees felled for treatment. Remainder burned standing.
Estimated 1932	48.339	11.993		44.510	

Caribou National Forest

Year	Acreage	Trees Treated	Cost per Tree	Total Cost	Remarks
1929		386			
1930	3,240	1514-Fall 1929 3049-Spring 1930	$ .98	$ 2,981.00	No cost figures available fof trees treated fall of 1929.
1931	14.980	15,539		16,558	
Estimated 1932	24.000	11,241		21.000	

Cache National Forest

Year	Acreage	Trees Treated	Cost per Tree	Total Cost	Remarks
1929		7.906	.34	2,699.00	
1930	23,250	17,158	.54	9,234.00	
1931	34,000	9,150	.801	7,332.00	
Estimated 1932	84,955	3,837	1.44	6,394.00	$1000 for fall control 1931 - 586 trees treated

Beaverhead (Madison) National Forest

Year	Acreage	Trees Treated	Cost per Tree	Total Cost	Remarks
1931	23,000	5,870	3.91	22,976.00	
Estimated 1932	15,104	32,030		65.000	

Yellowstone National Park

Year	Acreage	Trees Treated	Cost per Tree	Total Cost	Remarks
1931	12,344	2,888	2.69	7,767.00	Burned standing & Felled and Burned
Estimated 1932	117,826	43,999	2.50	110,000.00	Estimate only

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

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HISTORY OF THE MOUNTAIN PINE BEETLE INFESTATION IN THE LODGEPOLE PINE STANDS OF MONTANA

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INTRODUCTION

This memorandum has been prepared for the purpose of presenting to interested officials a brief history of the destructive mountain pine beetle (Dendroctonus monticolae Hopk.) epidemic, which during the past twenty-five years has ravaged the lodgepole pine forests of Montana. The information contained in this manuscript will illustrate the seriousness of the destruction which has occurred as well as the extreme difficulty experienced in attempts to prevent this devastation. An effort has been made to eliminate from this paper all tedious details, and it is trusted that in this desire for brevity in a necessarily long narrative essential facts have not been omitted.

Before discussing the rather intricate course of this outbreak, the writer desires to emphasize the relationship which the flight habits of the mountain pine beetle bear to a proper analysis of this situation. Officers of the Bureau of Entomology are satisfied as to the spread of serious outbreaks of this insect in lodgepole pine. This fact has been clearly demonstrated in many instances during the past decade, and flights of fifteen miles or more also appear unquestionable. Inference must not be made that outbreaks of these insects do not develop locally, but when they have developed into serious infestations they continue to spread over tremendous areas. Though the writer believes in the ability of this insect to fly long distances, or at least to be carried by favorable air currents, positive proof

of this position is not available and is difficult to secure. The spread of such infestations can not be foreseen, nor can the distance or direction of such flights be accurately predicted. However, it is fully recognized that blocks of infested trees are a menace to uninfested timber stands, not only immediately adjacent but some distance removed. It is trusted that the reader of this manuscript will associate this question of insect flights to all phases of the situation, as it has a direct bearing upon past and future timber losses as well as the difficulties which have been experienced in the administration of control.

EARLY HISTORY OF THE MONTANA INFESTATION

In 1909 an outbreak of the mountain pine beetle was reported from the white pine and lodgepole pine stands of the Flathead National Forest, approximately 125 miles north of the Big Hole Basin, Beaverhead National Forest. In 1912 control measures were directed against this outbreak, and approximately 28,000 infested trees treated on a relatively small acreage at Swan Lake. It is apparent that this outbreak was far more widespread than assumed by those in charge, and that control measures were confined to heavy centers of infestation only, leaving outlying groups of infested trees to develop into an epidemic which spread southward into the Missoula National Forest. By 1915 this infestation was well distributed throughout the northern portion of the Missoula Forest, and was in a measure officially forgotten, as apparently the life and potential spread of such an

outbreak was not foreseen at that time. At the request of the Forest Supervisor the writer examined the northern portion of the Missoula Forest in May 1921. At that time it was found that the infestation had spread throughout all of the lodgepole pine stands of the Blackfoot River drainage, with extremely heavy centers of infestation at Lincoln and Helmville, Montana, some seventy miles from the Swan Lake project.

Available records also show that another local outbreak of this insect was reported from the Big Hole Basin, Beaverhead National Forest, in the year 1911. During the season of 1912 and 1913, some 25,000 trees were treated, which were distributed in fairly small groups over a rather large acreage. This work was successful, as from that time until 1926 no further losses were recorded. Furthermore, when control measures were instituted within this same area in 1926, in an attempt to check the spreading Bitterroot infestation, which will be discussed later, there were no indications of depredation following the 1913 project.

So in the early history of this infestation we had two local outbreaks--one promptly checked by artificial control and the other allowed to continue in its destruction. And as this history continues it will be seen that the success of the one project was lost through the failure of the other.

MORE RECENT HISTORY

During the winter of 1924 it became known that there were a number of lodgepole pine trees in the vicinity of Philipsburg, Montana, southern portion of the Missoula National Forest, that had been killed by the mountain pine beetle. This area was only some thirty miles from the heavy centers of infestation at Lincoln and Helmville, Montana, located by the writer in 1921. As valuable timber stands lay directly in the southern path of the 1924 Philipsburg infestation, which was considered as having spread from the infested areas to the north, the situation was considered as justifying the institution of control. Without the advantage of an adequate survey, it was necessary to consider this infestation as constituting the head of the advancing epidemic. The Philipsburg basin, an area devoid of timber, was adopted as a "No Bug's Land," and plans formulated to treat all infested trees to the south of this hoped-for barrier. In the spring of 1924 a few hundred dollars were expended in the treatment of some 1,000 trees distributed throughout this area.

This plan was soon shown to be ineffective, as a survey conducted during the summer of 1924 showed the head of the infestation to be on the East Fork of the Bitterroot River, some few miles further to the south, where heavy centers of attacked trees were recorded.

Late in the winter of 1924 and 1925 a few thousand dollars were made available to combat the heavy infestation on the Bitterroot.

The expenditure of this small appropriation, which permitted the treatment of only 7,725 trees, had no effect in checking the spread of this serious outbreak. A survey of the area in the fall of 1925 showed that the inevitable had occurred, and that the beetles had spread into the treated areas, infesting ten trees where but one had been treated the previous spring. This survey also showed that across the Continental Divide to the south there were several large spots of infested trees on the west side of the Big Hole Basin, where in 1924 only a few scattered red-tops were present.

In the spring of 1926 another effort was made to prevent the infestation on the east fork of the Bitterroot from spreading down the river, by treating all of the infested trees on a much wider zone of defense than covered the previous season. At the same time control measures were instituted in the Big Hole Basin, with the idea that the Continental Divide would at least act as a partial barrier to the continued spread of the Bitterroot infestation into these valuable timber stands.

A more intensive survey conducted during the summer of 1926 demonstrated the fallacy of continuing the effort to check the spread of the infestation down the Bitterroot River, and this part of the project was discontinued. This survey also indicated that there had been a heavy flight of beetles across the Continental Divide, heavily reinfesting the area covered by control the previous spring.

Still hoping that the Big Hole Basin might be held against the influx of beetles from the Bitterroot, the Bureau of Entomology

again recommended the institution of control on the west side of the basin for the spring of 1927. During this operation approximately 18,000 trees were treated at a cost of $31,500, on practically the same acreage as covered in 1926, when only 5,271 trees were treated. Again the results of the fall survey were discouraging, for not only were the treated areas heavily reinfested, but practically the entire basin area was now found to be infested.

During the 1927 season a new source of danger to the success of the Big Hole Basin project was recognized. With its source a matter of conjecture, an outbreak of the mountain pine beetle in the lodgepole pine stands of the Salmon National Forest reached a serious epidemic stage. As this forest is adjacent to the Beaverhead on the west, this situation placed the future of the project in a more doubtful light than ever before. In fact, there were large blocks of infestation just over the Continental Divide from which insects had undoubtedly already spread into the southern portion of the Big Hole Basin and other units of the Beaverhead.

However, realizing that if the infestation within the Beaverhead were allowed to continue in its southern spread valuable commercial and scenic forests would be destroyed, the Bureau of Entomology again recommended the institution of control in the spring of 1928, though cognizant that the chances of success were rather remote. During this project, which covered a large portion of the Big Hole Basin, some 64,000 trees were treated at a cost of $89,000, which was the

largest bark-beetle control project ever undertaken. The heavy reinfestation of this large acreage, as well as the occurrence of many newly infested areas, demonstrated the uselessness of attempting to continue this project in its present form. To have continued this project in 1929 would have required an expenditure of at least $500,000, with the assurance that still larger sums would no doubt be needed for several years or until no further reinfestation of the treated areas occurred.

The recommendation for the cessation of control on the Beaverhead Forest was made after consideration of all factors involved, and in full recognition of the seriousness of the position taken. At that time the Bureau of Entomology proposed another plan which was believed to offer some chance of checking the southern spread of this outbreak. This plan called for the utilization of the wide timberless areas between the Beaverhead and Madison Forests as a potential partial barrier to the insects. An annual survey was to be made of the Madison Forest, and all infested trees promptly treated.

In 1930 some small spots of infestation were discovered along the western border of the Madison National Forest. At the same time it was discovered that an area of public domain known as the Sheep Creek Hills, which lies between the Beaverhead and Madison Forests, but some twenty miles from the nearest infestation on the Beaverhead, was lightly infested. In the spring of 1931 control measures were instituted in these two areas, and all known infested trees treated.

Once more the effort to check this outbreak appeared futile, for during the summer of 1931 the treated areas were heavily reinfested.

To complete this early history it is now necessary to return to the year 1928, for at that time infestations of the mountain pine beetle were found in the commercially valuable lodgepole pine stands of the Targhee National Forest of Idaho. As the Targhee Forest borders the Yellowstone Park on the southwest, the presence of this infestation constituted a real menace to the scenic forest of the Park. The known infestation (2,752 trees) within the Targhee was treated in the spring of 1928, but a survey conducted that summer showed that the outbreak was far more widespread than had been anticipated, and was also present within the Teton, Caribou, Wyoming, and Cache National Forests. In the spring of 1929 control measures were instituted on these forests, and all infested areas covered by control. The following tabulation shows the number of trees treated:

Targhee	31,204	trees	treated on	14,000 acres
Teton	651	"	"	Unknown
Wyoming	6,945	"	"	"
Caribou	386	"	"	"
Cache	7,906	"	"	"

Once more surveys conducted in the fall of 1929 disclosed the fact that marked increases in the infestation had occurred on all of the forests except the Targhee, where the number of infested trees remained about the same except that they were distributed over a much

larger acreage. In the spring of 1930 control measures were again directed against these increased outbreaks, and all infested areas covered by control. The number of trees treated and acreages covered are shown:

Targhee	30,064	trees	treated	on	67,948	acres
Teton	4,515	"	"	"	4,000	"
Wyoming	17,160	"	"	"	60,800	"
Caribou	4,563	"	"	"	3,240	"
Cache	17,150	"	"	"	23,000	"

Subsequent surveys of these forests showed that no noticeable results had accrued from the institution of control, as on most areas the infestation showed a marked increase resulting from the 1930 attacks. These surveys also disclosed that a light infestation of this insect was then present in the southwest portion of the Yellowstone Park.

The spring of 1931 again saw the institution of control on all of these forests, with a real effort being made to locate and treat every infested tree. The following tabulation shows the trees treated and acreage covered:

Targhee	35,951	trees	treated	on	102,870	acres
Teton	4,762	"	"	"	4,500	"
Wyoming	105,000	"	"	"	17,055	"
Caribou	15,539	"	"	"	14,980	"
Cache	9,150	"	"	"	34,000	"
Yellowstone	2,888	"	"	"	12,344	"

Following this thorough effort of control all of the forests associated with the project were covered by an adequate survey in the fall of 1931, which once more presented very discouraging data. These data follow:

	Trees Infested 1931	Acres
Beaverhead	12,238,000	622,000
Gallatin	6,557	35,000
Madison	32,000	15,104
Targhee	119,874	438,000
Teton	1,400	4,500
Wyoming	11,993	48,339
Caribou	11,241	24,000
Cache	3,837	84,955
Yellowstone	43,999	117,826

Amount spent for control 1931 -- $163,761

Amount needed to cover same area in 1932 -- $650,000

In view of the uncertainty of success as well as the large sums of money which would be needed to continue this project for a number of years, further efforts of control were temporarily discontinued. Though work was discontinued on the Madison, Targhee, Caribou, and Yellowstone, control measures were conducted on the Teton, Wyoming, and Cache National Forests during the 1932 and 1933 seasons. In adopting this drastic position it was understood that all of the forests associated with this project were to be surveyed each year,

and if at any time conditions appeared more favorable the matter was to be brought to the attention of proper authorities.

Before closing this phase of the project history, it would seem that a brief discussion of the infestation on the Targhee, Teton, Wyoming, Caribou, and Cache Forests would be of interest and would serve to more clearly depict the present situation. In considering the infestation on these forests we are at once confronted with the question of its source, which is unknown. Outbreaks of this insect develop locally, and it is possible that the situation on these five forests developed from existing normal or endemic infestations. With our present knowledge of the flight potentials of insects when carried by air currents, an influx of beetles from the heavy centers of infestation to the northwest is perhaps not an impossibility. The fact that these outbreaks occurred as a rather progressive step in the Montana epidemic lends some argument to the flight possibility. The writer has no definite opinion on this matter aside from the fact that no doubt both solutions are possible. However, regardless of the position taken, an explanation must be given to account for the annual reinfestation of the treated areas. Needless to say, the insects come from untreated trees either within or immediately adjacent to the treated units or from areas some distance away. To throw more light on this mooted question, which had a very direct bearing upon the future of the Yellowstone project, the 1931 control operation was instituted

on the basis of a 100 percent clean-up of all infested trees. Through the adoption of such a clean-up policy it was thought by those in charge of the operation that if the treated areas were again heavily reinfested during the summer of 1931 one would of a necessity feel that insects were flying into the areas.

This discussion brings the history of the Yellowstone-Region 4 bark-beetle control project up to the fall of 1931, at which time it was discontinued because of the expense of the operation and the uncertainty of success. But, as stated, the situation was to be held under careful observation, and re-opened for consideration if at any future time control appeared more feasible.

PRESENT SITUATION

In the fall of 1932 insect surveys were again conducted on all of the forests associated with the Yellowstone-Region 4 control project. The data from these surveys were not as discouraging as had perhaps been anticipated. There were marked increases on the Madison, Gallatin, Caribou, and Targhee Forests, with fairly satisfactory reduction in the amount of infestation on the Teton, Wyoming, and Cache, where control measures had been directed against the 1931 infestation. The 1932 infestation on these forests was as follows:

Beaverhead	17,586,000 trees
Madison	19,317 "
Sheep Canyon (Public Domain)	151,000 "
Gallatin	17,393 "
Targhee	170,862 "
Teton	230 "
Wyoming	2,928 "
Caribou	18,756 "
Cache	717 "
Yellowstone	40,590 "
Teton Park	281 "

An analysis of these data placed the project in a more favorable light than existed the previous season, and no irrecoverable loss had followed the cessation of control in the fall of 1931. Though an increase occurred in the Targhee infestation, it was not

abnormal, and was well within the potential increase from the infestation existing on the area. The infestation in the Yellowstone was confined to the whitebark pine stands at high elevations, for which protection was not especially desired. However, the infestation on the Beaverhead and adjacent areas on the Madison continued to increase to alarming proportions, constituting a real menace to the success of control on other areas. As funds had been provided for further control on the Teton, Wyoming, and Cache Forests, the writer believed that the re-institution of control on the Targhee would be justified. This position was based upon the need for the elimination of the rapidly developing centers of infestation on the Targhee, which would soon become, if they had not already, a source of reinfestation to the adjacent forests where control was being conducted. In making this recommendation the writer realized that no assurance of success could be given, but in view of the appalling devastation which lay in the wake of this outbreak it was believed that even a slight chance justified the expenditure. Funds were not available for the adoption of this plan, though control measures were again conducted on the Wyoming and Cache.

During the winter of 1932-33 a distinct "break" occurred in the infestation. Extremely low temperatures in December 1932, and again in February 1933, were followed by a very high mortality in the overwintering broods of the mountain pine beetle. This mortality

varied for different areas, depending of course upon the range of the low temperature. On the Beaverhead Forest the mortality was very heavy, reducing the infestation from 17,586,000 trees in 1932 to 915,000 in 1933. On the Targhee it was estimated that approximately 50% of the overwintering broods were destroyed, which can be assumed to have reduced the 1933 attack by an equal amount.

With this "break" in the infestation as an encouragement, the forests of the Yellowstone project were again covered by an insect survey in the fall of 1933. Data follow:

Beaverhead	915,597
Madison	7,504
Sheep Canyon	14,868
Gallatin	18,956
Targhee	303,188
Teton	585
Wyoming	4,737
Caribou	63,022
Cache	2,015
Yellowstone	61,005
Teton Park	1,500

Again the analysis of these data seemed to place the Yellowstone project in a still more favorable light. It was apparent that in the northern forests--Beaverhead, Salmon, and those areas adjacent, that were subjected to extreme low temperatures the previous

winter--a much higher brood mortality had occurred than in the more southern forests of the project. Though on the Targhee, Teton, Wyoming, Caribou, and Cache Forests there were no appreciable changes in the status of the infestation as a result of low temperatures, one can correctly assume that the infestation on the Targhee was materially reduced as a result of this abnormal mortality, and it is possible that the same conditions existed to a less degree on the more southern units. Though on several of the forests the 1933 situation was of a more serious character than at the time work was discontinued in 1931, it was evident that the entire project could be viewed in a more favorable light. Work was discontinued in 1931, as it was assumed that for a number of years, no matter how thoroughly the infested units were covered by control, there would be an annual reinfestation from sources outside of the area. The so-called "break" in the infestation had been of value in eliminating or at least reducing these potential sources of reinfestation. The outbreaks on the western portion of the Challis and Salmon Forests of Idaho had subsided to a point where they could no longer be considered as danger points, and the severe winter-kill on the Beaverhead had practically eliminated the source of reinfestation. However, it was realized that sufficient timber still remained on the eastern Beaverhead and the Gallatin Forest to permit the infestation to rebuild to its former seriousness and defeat the success of control.

At this point the writer desires to quote from his report of December 22, 1933, in which the 1933 situation is summarized and recommendations made for control:

"If the present status of the mountain pine beetle infestation in the lodgepole pine stands of the different units of the Yellowstone project is studied, with the memory of the devastation which has occurred on the Beaverhead and central Idaho forests, the seriousness of the situation is more fully appreciated. Since the cessation of control in the spring of 1931, the Targhee infestation has developed to a degree which during the next few years will increase rapidly and unless checked by natural or artificial means will destroy not only the timber stands of the Targhee but adjacent forests as well. Though the economic importance of this situation can be appreciated, it is difficult to evaluate. Commercial timber stands can be appraised, but the scenic values of the forests which are at stake are difficult to weigh. What effect such an epidemic will have upon the timber stands in question is difficult to depict, and reference can only be made to the devastation which has occurred on the Montana and central Idaho forests, where on large areas 75% of all trees of 6" or more in diameter have been killed.

"In studying the entomological aspects of this situation, there are no reasons to assume that success should not follow the institution of artificial control, though of course it can not be

assured, and the following recommendations are based upon the entomological phases of the problem only. Though the present situation has been described in some detail, with a brief attempt at forecasting future depredations, it would seem that the final decision as to the economics of the expenditures recommended should rest upon the agency charged with the responsibility of the timber lands in question.

"In view of the seriousness of the present situation, as well as the rather evident fact that if control is not instituted on the Targhee in the spring of 1934 it will no longer be feasible, it is recommended that the Yellowstone project be re-opened in the spring of 1934. In re-opening this project it is recommended that the infested portion of all units be covered with as thorough a clean-up as possible. The Yellowstone problem is a difficult one to correctly analyze. It is possible that our activities should be directed toward the infestation in lodgepole pine only, with no attention being paid to the outbreak in whitebark pine, though the writer sincerely believes that an interchange of these hosts is inevitable. If this occurs, it would be a simpler operation to cover the rather small areas now infested than the large bodies of lodgepole once a spread has occurred. It is therefore recommended that the most accessible areas and those adjacent to the susceptible lodgepole pine forests be included in this project.

"The following requests for funds have been made by the Forest

Service and Park Service, to which I concur, with the listed reservations:

Unit	Funds Requested	Writer's Comments
Yellowstone	$125,000	This amount will not be sufficient to cover the areas where control is necessary. Would suggest $180,000, as the cost of treatment in these remote areas will be at least $3.00 per tree.
Targhee	$300,000	Would suggest an additional $25,000.
Caribou	63,000	Should be sufficient.
Cache	4,000	Should be sufficient.
Wyoming	15,000	Would suggest an additional $6,000 to treat the adjacent whitebark pine infestation.
Teton	15,000	Would suggest an additional $5,000 to effect a good clean-up of the newly infested area near the 1931 Gravel Creek fire.

"To this total of $512,000 which has been estimated as being necessary for the treatment of all the project units, the writer would recommend the allotment of an additional $91,000. This recommendation does not take into consideration any IMPNIRA funds which have been previously allotted to Region Four. It is recognized that this is a large appropriation, and it is possible that even in the event of the writer's recommendations being accepted sufficient funds will not be available. If any reduction in this allotment is to be made, it is recommended that the work

in the Yellowstone unit be restricted to the lodgepole infestation in the Bechler area, which would necessitate an expenditure of some $5,000 instead of $180,000 as estimated, though this is recommended. The reason for this position is that there is a question as to the infestation in the whitebark pine stands spreading into the lodgepole. However, there would seem to be no other possible separation of the remaining units, as the infestation is so closely connected that areas left untreated will seriously affect the results of control on the others, and eventually cost far more for control than the original estimate. A further reduction in the allotment of funds for the institution of control within these forests will prove to be false economy."

Though these recommendations were approved, no action was taken.

The 1934 situation is unknown at this time, but after adequate surveys are made in the fall a report will be submitted.

STATISTICAL HISTORY OF THE MOUNTAIN PINE BEETLE INFESTATION ON THE FORESTS OF THE YELLOWSTONE-REGION 4 BARK-BEETLE CONTROL PROJECT

BEAVERHEAD NATIONAL FOREST

Year of attack	Acres infested	Trees per acre	Number infested trees	Remarks
1925	17,920	.294	5,271	Trees treated 1926
1926	18,588	.937	17,418	Trees treated 1927
1927	299,520	.183	55,045	Trees treated 1928
1928	1,341,860	.239	321,372	No control
1929	1,341,860	1.553	2,084,123	" "
1930	1,341,860	2.858	3,835,958	" "
1931	1,341,860	11.478	15,402,520	" "
1932	1,341,860	13.105	17,586,171	" "
1933	1,341,860	.682	915,597	" "

SHEEP CANYON AREA (PUBLIC DOMAIN)

Year of attack	Acres infested	Trees per acre	Number infested trees	Remarks
1930	2,345?	1.298	3,045	Treated 1931. Timbered acreage only. Not treated. Acreage includes total area surveyed. 4000 acres used to compute trees per acre.
1931	23,680	5.795	23,183	
1932	23,680	37.750	151,000	Ditto
1933	23,680	3.714	14,858	Ditto

MADISON NATIONAL FOREST

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
1930	13,889	.203	2,825	Treated 1931. Timbered acreage only.
1931	45,780	.387	6,975	Not treated. Acreage includes total area surveyed. 18,000 acres used to compute trees per acre.
1932	45,780	1.073	19,317	Ditto
1933	45,780	.416	7,504	Ditto

GALLATIN NATIONAL FOREST

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
1931	62,720	.154	9,676	
1932	114,660	.151	17,383	
1933	141,440	.134	18,956	

TARGHEE NATIONAL FOREST

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
1927	5,000	.550	2,752	Treated spring 1928
1928	14,800	2.108	31,205	Treated spring 1929
1929	67,948	.442	30,064	Treated spring 1930
1930	102,870	.349	35,987	3,671 treated fall 1930 32,316 treated spring 1931
1931	480,427	.249	119,674	Not treated
1932	494,587	.345	170,862	" "
1933	464,284	.653	303,188	" "

TETON NATIONAL FOREST

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
1928			651	Treated spring 1929
1929	4,000	1.128	4,515	Treated spring 1930
1930	4,500	1.058	4,762	Treated spring 1931
1931	4,500	.325	1,461	Treated spring 1932
1932	4,500	.051	230	
1933	4,500	.130	585	
1933	9,577	.967	9,263	New area - Adjacent 1931 burn - NE corner forest

GRAND TETON NATIONAL PARK

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
				Treated spring 1932.
1931			283	Jenny's Lake. Light attacks.
				Treated spring 1933. W.B.pine.
1932			261	Glacier & Death Canyon areas.
				Treated fall 1933. W.B.pine.
1933			75	Glacier, Death Canyon, Cascade areas.
1933	6,000	.35	1,500	Lodgepole pine. Windy Pt area.

WYOMING NATIONAL FOREST

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
		Grey's River		
1928			6,945	Treated 1929
1929	60,800	.282	17,160	Treated 1930
1930	106,022	.162	17,277	2,055 treated fall 1930. 15,222 treated spring 1931.
1931	24,680	.134	3,325	Treated fall 1931
1932	10,630	.275	2,928	Treated spring 1931
1933	8,959	.371	3,324	
		Green River		
1932	500?	2.156	1,078	Treated fall 1932. Data as to acreage uncertain
1933	?		1,413	Data incomplete

CARIBOU NATIONAL FOREST

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
1928	572	.928	531	Treated spring 1929
1929	3,240	1.335	4,327	1,258 treated fall 1929 3,079 " spring 1930
1930	14,980	.770	11,539	Treated spring 1931
1931	24,000	.468	11,243	Not treated
1932	34,829	.538	18,756	" "
1933	40,090	1.572	63,022	" "

CACHE NATIONAL FOREST

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
1928			7,906	Treated spring 1929
1929	27,418	.625	17,158	2,605 treated fall 1929; 14,553 treated spring 1930.
1930	34,000	.269	9,150	Treated spring 1931
1931	35,458	.164	5,837	586 treated fall 1931; 5,251 treated spring 1932.
1932	17,266	.041	717	Treated fall 1932
1933	14,311	.140	2,347	

YELLOWSTONE NATIONAL PARK

Year of attack	Acres infested	Infested trees per acre	Number infested trees	Remarks
				Trees treated spring 1931.
1930	12,344	.233	2,888	Bechler River control unit.
1931	117,826	.373	43,999	General survey of entire park
1932	117,826	.344	40,590	" " " " "
1933	202,113	.301	61,005	

Photograph No. 1

Heavy center of infestation on the East Fork of the Bitterroot River, showing practically all trees above 6 inches in diameter to have been destroyed by the mountain pine beetle. By the use of panchromatic plates the red foliage of the dying and dead trees appears white. Picture taken August 1924 by H. J. Rust.

Photograph No. 2

Historic Battlefield in the Big Hole Basin. This area marks the scene of an engagement between the Nezperce Indians under command of Chief Joseph and United States forces under Colonel Gibbons. This engagement took place on August 9th, 1877. All of the trees within the historic battle ground are now dead as a result of mountain pine beetle attack. Photograph taken by James C. Evenden in 1933.

No. 1

No. 2

Photograph No. 3

Museum, Big Hole Basin Battlefield, containing some of the mementos of the engagement between the Nezperce Indians and United States forces. All trees surrounding this museum are now dead as a result of mountain pine beetle attacks. Photograph taken in 1932 by James C. Evenden.

Photograph No. 4

Trail Creek, Big Hole Basin, showing practically a 100 percent kill of the lodgepole forests as a result of mountain pine attack. Photograph taken by E. E. Miller. In 1925 there was not a dead tree to be seen in this area.

No. 3

No. 4